

NOTE

Overwintering Cave Mosquitoes (Diptera: Culicidae) of the Arkansas and Missouri Ozarks

Some 60 species of mosquitoes occur in Arkansas and Missouri (Darsie and Ward 1981, Crockett 2002). We have long known that mosquitoes occur in Ozark caves, but few species records have been available in the literature. As a result of extensive collecting effort in Missouri caves by the Missouri Department of Conservation and in Arkansas caves by the Subterranean Biodiversity Project at the University of Arkansas we now know of four species that occur in Ozark caves.

The specimens recorded here are all females found in caves in late fall, winter, and early spring. Few mosquitoes were observed in caves during the summer months despite an equal degree of collecting effort during those months. Mated females apparently enter caves to pass the winter. Male mosquitoes are rarely collected in caves. Ives (1938) found only 8 males among 3102 specimens collected in Tennessee caves. They were all found in the early part of the hibernation period and may not have lived far into the winter.

Anopheles punctipennis (Say).—ARKANSAS: 1 ♀, Newton County, Tom Watson's Bear Cave, 26 January 2002. MISSOURI: 1 ♀, Boone County, Hunters Cave, 1 November 1998. 2 ♀, Crawford County, Campsite Cave, 18 December 1998. 5 ♀, Maries County, Indian Ford Cave, 4 January 2002. 2 ♀, Maries County, Indian Ford Crevice Cave, 4 January 2003. 2 ♀ McDonald County, MoDot Cave, 21 November 2002.

Anopheles punctipennis adults are nocturnal, resting during the daytime in hollow trees, under rock overhangs, and in similar dark, moist shelters (Irby and Apperson 1992). Females take blood meals from mammals and birds. They rarely enter

homes to feed. Females winter in buildings, cellars, hollow trees, and other well-protected shelters (Carpenter and LaCasse 1955, Horsfall 1955). In caves, they tend to congregate in the twilight zone. Movement into and out of caves is apparently governed by outdoor temperature (Ives 1938, Hess and Crowell 1949). Adult females emerge from overwintering quarters as early as February, take blood meals, and lay eggs (Breeland et al. 1961). This species was previously recorded from Canadian caves by Peck (1988); Massachusetts subterranean habitats by Berg and Lang (1948); a New York cave by Lawlor (1935); Tennessee caves by Ives (1938); Kentucky caves by Barr (1967); Illinois caves by Peck and Lewis (1977); and Bat Cave, Crawford County, Missouri, by Craig (1977).

Culex erraticus (Dyar and Knab).—ARKANSAS: 2 ♀, Marion County, Brown Cave, 16 November 2001. 1 ♀, Marion County, Reed Cave, 9 March 2002. 1 ♀, Marion County, Reed Cave, 15 November 2001. 1 ♀, Newton County, Big Hole, 10 November 2001. 4 ♀, Newton County, Saltpeter Cave, 17 March 2002. 2 ♀, Newton County, Tweet's Cave, 26 October 2001. 4 ♀, Stone County, Gustafson Cave, 6 October 2002. 2 ♀, Stone County, Hidden Spring Cave, 5 October 2002. MISSOURI: 4 ♀, Benton County, Estes Cave, 8 November 2002. 2 ♀, Boone County, Hunters Cave, 1 November 1998. 1 ♀, Boone County, Hunters Cave, 16 October 2002. 2 ♀, Boone County, Rocheport Cave, 6 September 2002. 2 ♀, Camden County, Adkins Cave, 8 November 2002. 3 ♀, Camden County, Moles Cave, 27 January 2003. 1 ♀, McDonald County, McDot Cave, 21 November 2002. 4 ♀, Shannon County, Banker Cave, 13 December 1998. 3 ♀, Shannon

County, Forester Cave, 17 October 1998. 2 ♀, Shannon County, Knee Suck Cave, 20 January 1998. 4 ♀, Wright County, Little Smittle Cave, 14 November 2002. 2 ♀, Wright County, Lowell Cave, 13 November 2002.

At dusk, *C. erraticus* females move from sheltered marsh and swamp forest sites to nearby grasslands (Snow 1955), where they take blood meals opportunistically from mammals, birds, reptiles and amphibians (Robertson et al. 1993, Williams and Meisch 1981). During the day, they rest on vegetation and in natural and man-made sheltered areas (Irby and Apperson 1992). This is the most common species found wintering in Ozark caves during the course of this study. It was previously reported from Missouri caves by Sutton (1993).

Culex pipiens Linnaeus or *C. quinquefasciatus* Say.—ARKANSAS: 1 ♀, Benton County, Marshall Caves, 18 December 1999. MISSOURI: 2 ♀, Camden County, Adkins Cave, 8 November 2002. 2 ♀, Maries County, Indian Ford Cave, 4 January 2002. 1 ♀, Polk County, Mcdermic Cave, 15 March 2001. 5 ♀, Wright County, Little Smittle Cave, 15 December 1999.

Only females of this species were seen. It is not possible to reliably determine if the specimens are *C. pipiens* or *C. quinquefasciatus*. The northern and southern house mosquitoes are commonly found in homes, and they bite humans at night. Adults rest during the daytime on vegetation and in natural and man-made sheltered areas (Irby and Apperson 1992). *Culex pipiens* comprised 89% of the 1562 mosquitoes found wintering in a small natural cave in the city of Montpellier, southern France, between October 1997 and the following March. Only four of the specimens were males (Gazave et al. 2001). *Culex pipiens* was previously recorded from Massachusetts subterranean habitats by Berg and Lang (1948), a New York cave by Lawlor (1935), Tennessee caves by Ives (1938), and Illinois caves by Peck and Lewis (1977). It was found in large numbers in a Minnesota

mushroom cave in early March (Owen 1937).

Uranotaenia sapphirina (Osten Sacken).—MISSOURI: 1 ♀, Boone County, Hunters Cave, 1 November 1998. 1 ♀, Camden County, Moles Cave, 27 January 2003. 5 ♀, Oregon County, Long Point Cave, 1 April 1998. 1 ♀, Wright County, Little Smittle Cave, 14 November 2002.

Uranotaenia sapphirina adults are most active in early evening. They rest during the day in dark cavities and other protected shelters (Irby and Apperson 1992). Peterson and Smith (1945) reported this species overwintering in considerable numbers in hollow trees with *Anopheles quadrimaculatus* Say and *A. punctipennis* in Mississippi. It was collected from a cave in eastern New York State in February, along with *A. punctipennis* and *C. pipiens* (Lawlor 1935).

The cave-inhabiting mosquito species are not restricted to overwintering in caves. They will choose any convenient dark, moist, sheltered area that provides protection from freezing temperatures, such as hollow trees, mammal burrows, rock piles, wells, mine shafts, culverts, cellars, sheds, stables, and similar structures (Shemanchuk 1965, Zukel 1949).

Most of the Ozark mosquitoes that have not been found in caves winter as eggs or larvae. Aside from the four species recorded here, local species that are thought to overwinter as fertilized adult females include *A. quadrimaculatus*, *Culex peccator* Dyar and Knab, *Culex restuans* Theobald, *Culex salinarius* Coquillett, *Culex tarsalis* Coquillett, *Culex territans* Walker, and *Culiseta inornata* (Williston). We might expect to find these overwintering in Ozark caves. Among them, *A. quadrimaculatus* (Hess and Crowell 1949, Ives 1938, Peck 1988) and *C. restuans* (Peck 1988) have been found overwintering in caves elsewhere. *Culex territans* (misidentified as *C. apicalis*) has been found overwintering in subterranean basement structures (Berg and Lang 1948). Adult female *Culex tarsalis* have been found wintering in abandoned mine

tunnels in Colorado (Mitchell 1979, Blackmore and Dow 1962) and Nevada (Chapman 1961) and in rodent burrows in California (Mortenson 1953). *Culex tarsalis* and *C. inornata* have been found wintering in subterranean burrows of large mammals in Canada (Shemanchuk 1965). Our *Aedes*, *Ochlerotatus* and *Psorophora* species are thought to overwinter in the egg stage. Adult *Aedes canadensis* (Theobald), *A. cinereus* Meigen, *A. vexans* (Meigen), and *Ochlerotatus sticticus* (Meigen) have been found in Canadian caves in late spring and summer, but not in winter (Peck 1988).

The Missouri specimens recorded here are the property of the Missouri Department of Conservation, Jefferson City. They will be deposited in the Enns Entomology Museum, University of Missouri, Columbia. The Arkansas specimens are deposited in the University of Arkansas Arthropod Museum, Fayetteville.

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- Jeffrey K. Barnes, *The Arthropod Museum, Department of Entomology, University of Arkansas, Fayetteville, Arkansas 72701, U.S.A. (e-mail: jbarnes@uark.edu).*